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ABSTRACT

Within the context of a discussion of the challenges facing Canadian higher education, this paper reviews some of the innovative approaches to student retention, curriculum development, and modularization in use at Mohawk College in Ontario. After stressing the need for innovation in advanced technological education in Canada, the paper offers an overview of the effects of new technologies on employment and employers' needs for workers skilled in reading, mathematics, problem solving, and interpersonal relations. Next, economic challenges facing Canada are examined, highlighting the country's poor record in the development and adoption of new technology, international trade imbalances, and changes in student characteristics that complicate the task of developing human resources through education. Arguing against current educational models that parallel the competitive nature of the business world, the paper advocates cooperation among and between students and faculty. The next section briefly describes some innovative practices used in Mohawk College's new, modularized two-year program in systems analysis/design and programming languages, including: (1) an emphasis on students' problem-solving and writing skills; (2) course assignments that promote active learning and student responsibility for learning; (3) assignments that force students to produce original work and discourage cheating; and (4) the use of student teams in large systems analysis/design projects. A sample course assignment is described. Finally, the paper stresses the importance of continuing innovation in Canadian higher education. Twenty-three endnotes are attached. (VVC)

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A STRATEGY FOR INNOVATIVE TEACHING

A BACKGROUND PAPER FOR

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ACCC CONFERENCE '89,

RENAISSANCE: INNOVATIONS IN EDUCATION

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UNDERSTANDING OUR OPERATING ENVIRONMENT

Some of us in the colleges are now actually trying to understand the world around us, particularly the technological world and the world of work. I say this in contrast to two other ways of dealing with our operating environment that I believe some college teachers use to cope with change and complexity. One is to accept what is written and predicted by the gurus and be guided by these conventional wisdoms. The other is to simply ignore the so-called real world and proceed along the time-worn path that many students believe most if not all instructors follow. These methods are clearly undesirable. Niels Bohr, the late Nobel laureate in physics said, "Predicting is difficult, particularly the future.", [1] and perhaps this is the properly skeptical view we should take of prognostications from the futurists. As for the second method I would simply point out that teachers must by definition lead; they should seek out new ways to do new things and should not be preoccupied by the inherent riskiness of new ventures.

Really we have no choice. There is now in this country a glimmer of recognition that basic education will be key to our survival and prosperity in the next century. Colleges must play a pivotal role, teaching the basic communication skills and the stock of knowledge needed to function in society, as well as the ability to learn, which will also be a key skill in vocational education. More of a sense of partnership with the private sector will be necessary and business must come to regard training as an investment that must be continually renewed.

It is quite clear that the graduates we turn loose on employers will have to be skilled in reading, mathematics, problem-solving and interpersonal relationships. Moreover there is a strong consensus among employers that workers will need more skills and more training than in past times because of the heightened scale and complexity of innovation (hard and soft technologies) being introduced to improve productivity. [2]

Richard M. Cyert and David C. Mowery who were respectively chairman and study director of a panel organized by the National Academy of Sciences , the National Academy of Engineering and the Institute of Medicine to assess the effects of new technology on employment and the U.S. economy, came to an important conclusion about basic skills for employment:

> "The historical evidence clearly shows that technological change has increased the value of such basic skills as reading, writing, numerical reasoning and problem solving. The computer-based technologies that are likely to be associated with jobs in the future will place even greater demands on the mental rather than the physical capabilities of factory and office workers. Furthermore, expanded use of work teams in many production systems also means that a premium will be placed on the ability to communicate effectively." [3]

Even with the efforts now being made in Canada, Larkin Kerwin, president of the National Research Council says our I.Q. (Innovation Quotient) is lagging behind that of other western nations and goes so far as to say that we are technological illiterates. Dramatically Kerwin points out we cut down more trees than any other country, yet we *import* all of our chain saws. We have an elaborate health-care system but we *import* stretchers. In shocking fact, Canada *imports* $460 million of manufactured goods every week! [4]

Kerwin prescribes much greater research spending at the federal level and the careful establishment of research/innovation networks involving industry, government and universities/colleges. For our part, the development of what really is a new infrastructure would demand thousands of highly trained technologists. To provide appropriate education and training for for this Age of Innovation will require the providers to adopt correspondingly innovative methods.

Proposals such as this usually evoke the question; "Can we afford it?" However, when it comes to increasing, improving and innovating in advanced technological education, the question perhaps should be, "Can we afford not to?"

Finally on this point, Jeannine David-McNeil of Montreal's Ecole des Hautes Etudes Commerciales, argues education policy is not just a question of social cost but an instrument of economic growth. Thus educational expenditures are a source, in the medium and long term of income and prosperity. [5]

THE CHALLENGES WE FACE

Before delving into specific and detailed challenges that lie ahead of us as individual teachers, it may be useful in perspective, to briefly outline some of the major hurdles rising in front of the Canadian economy in the short term.

The Economic Council of Canada in its Visions of Canada in the Year 2000 research project, notes that our record of developing and adopting new technology has been poor in comparison to that of our major trading partners.[6] This may explain in part why we have been unable to make any real productivity gains on the United States. In fact we are in much the same position as in 1965 and still fall about 10% below U.S. levels of per capita income and aggregate labour productivity. [7]

The Council points out that Canada's production strategy will have to focus on goods and services that are more knowledge-intensive and which embody greater value-added. [8]

Maintaining and better yet, improving our world position as a trader employing the strategy mentioned means greater priority must be given to developing our human resources through education especially at the college level where most of the programs are meant to prepare people to enter the workforce with productive skills.

What do we know about our students? We know that no two are alike in terms of their expectations and motivation. We know that many of our students came out of a secondary school system (in Ontario) where they did not really know how long they should have stayed there! We know that that many have part-time jobs, some even full-time. In fact the Carnegie Foundation for the Advancement of Teaching collected data that suggests upwards of sixty percent of college students spend anywhere from 15 to 37 hours a week working, which while meant to make college affordable, probably accounts for a big part of the 25 to 30% attrition rate experienced by many traditional college programs. [9]

Kenneth Green of UCLA's Higher Education Research Institute says students are "scared senseless about the future. They understand that, as they move into adulthood, they have to be well-off to be considered middle-class. Getting work experience can't wait until after college". [10]

This student compulsion to work may be related to some surprising findings about North American work habits in general. Harris Poll surveys in 1987 indicate that people are spending less time now on leisure pursuits and more time working than they did in 1973. [11]

We know that too many students have carefully avoided science and mathematics in high school. Dr. Alan King of Queen's University says that science is being lost in our secondary schools - it is now an elite subject. Mathematics and science are high risk courses and students are afraid to take them. [12]

We know that some high school graduates cannot read or write well enough to succeed in our technological world. Bloom notes that teachers of writing in state universities (whom he refers to as among the noblest and most despised laborers in the academy) have told him they cannot teach writing to students who do not read, and that it is practically impossible to get them to read, let alone like it. [13] Obviously the challenge is great because we not only have to help students to acquire basic skills necessary for advanced learning but at the same time, we must somehow convince them that this tremendous and arduous joint effort is for a worthwhile end.

A CHANGE IN OUTLOOK

It is doubtful if any of us can remember a time when we were not being lectured to about the great virtues and benefits of competition. Business bows to the word as if it were some God-given guiding principle and somehow we have integrated the idea of competition with the precepts of the work ethic and even democracy. There is a sense that achievement through competition is pure and self-cleansing and that goals reached any other way are less lofty.

Students are encouraged to compete in a variety of ways as they progress through the levels of the education system. At the tertiary level, the one perhaps most closely linked to the world of work, students are competing in terms of performance with their peers and with themselves. In fact one might even suggest that students and instructors engage in a form of competition; being the hard-driving, knowledgeable types that we are, we give heart-stopping assignments and the strong (and very competitive) student turns in work an order of magnitude better than the marking model we use for the assignment! If you are a teacher I suspect you can identify with such behaviour.

This approach works. At least it does when all the players know the rules and see it for the game it really is. Unfortunately many students coming into the colleges are unprepared to play and some others, perhaps the really wise ones don't want to. When the competitive approach to education does not work the usual result is student failure. Ultimately, the student simply may not be able to persist.

I find it interesting that real success in business, in research and in international relations always is the product of co-operation, not competition. Tough, risky projects like the economic production of oil from oil sands bring otherwise competitors together. Similarly, recent writing about Japan suggests that the secret of Japanese success lies not so much in their ability to compete in the marketplace but rather in their willingness to co-operate in the various stages of development, and production which must happen first.

What I'm getting at is this; learning is tough, hard work. It could be made more productive and enjoyable if we had mechanisms in place that encourage more co-operation; students with students, students with faculty, faculty with faculty, colleges with employers and so on.

In the last little while, there has been much more talk about quality in the colleges. Cross says that quality will be the focus for the nineties.[14] Now without wandering off into a lengthy exploration of what constitutes quality or how it might be measured, let me submit this simple notion to you; "Quality is improved when an increasing number of students are able to persist in their studies until they have successfully completed the program." Let me quickly add this is not to imply any reduction of standards or the mere pushing of students through mediocre programs. Rather it should be as Robertson Davies states, "Education is victualling a ship for a long voyage not just getting people through examinations." [15]

SOME INNOVATIVE PRACTISES

I teach information systems courses in a large computer studies department. To be more specific we teach computer fundamentals, a variety of business programming languages, systems analysis and design, software packages and so on. In the last few years we have been greatly concerned about two things; the currency of our programs and their relative attractiveness to potential students. It's not surprising then that much of our energy apart from that consumed by teaching responsibilities, has been directed to recruitment strategy and curriculum revision.

Recruitment is fascinatingly complex; what to do, what not to do, what's effective, what's affordable, the list goes on. It is not my intention to get into this large topic here except to say that usually if we stand back far enough we can see that our present recruitment practises are reasonably effective in the sense we usually attract enough students. The real problem is that we do not help students to persist in their studies as much as we could. In a sense its like throwing away a hard-won prize.

Of course some attrition is necessary. Miller says it is inevitable and desirable. When there are too many incompatibilities between the institution and the student, a parting of the ways may be in the best interest of both parties. On the other hand, pointing to research by Bowen and Minter, Miller supports the view that the most conspicuous mark of a healthy college is its ability to *attract* and *hold* students [16]

Many innovations have been made in our most recent recruitment efforts and more will surely follow. At the same time, some of us have recognized a number of relatively simple ways to keep students on track, moving forward and learning.

I have tried to sell the notion that co-operative approaches are effective in achieving difficult goals and many of the so-called innovations mentioned here have at their core, a spirit of co-operation. Dr. Kerwin proposes a bigger and broader co-operative assault on technological innovation and research in this country which is an example that involves a vast number of people in a largely co-operative effort wherein education plays an important part.

At Mohawk, for nearly twenty years now, we have operated co-operative programs (computer studies among them) so the values and benefits of co-op are well known to us and the approach is not for us at least, an innovation. However this area may hold a number of unexplored opportunities as we pursue different types of programs in the future.

Much of the material in this paper is intended to stress just how important higher technological education will be in Canada and how vitally urgent it is to do everything possible to cause effective learning in all those students we have managed to attract to our programs.

As I noted before, we have been very much preoccupied with recruitment and curriculum revision and of course with the pervasive and nebulous issue of quality. I believe many of my colleagues are starting to have a concept of quality which is analogous to a strong but flexible glue that should hold together all of our various teaching and learning activities and this in part, drives our curriculum development.

In terms of curriculum revision, we have come to view this seemingly onerous process as a major opportunity to innovate. Already our department has developed a new two-year program that is modularized and the experience gained there is benefitting development in other course and program areas in the department. In the revision project now well advanced for the three-year computer systems technology program, much greater emphasis has been put on careful selection of course and topic objectives. As well, there is a strong emphasis on developing student problem solving and communication skills and these two things are like filaments in a web connected many diverse courses. The two main subject streams in the program, systems analysis and design and programming languages, are firmly based on problem finding and problem solving methodology. Students are also expected to write more than they would have in the past and they do this by way of challenging assignments that require more research and more resourcefulness. Certainly more than before, students are expected to continually build on a basic platform of skills and tools acquired in rudimentary form in the early stages of the program. I guess you could say we want help develop "true wisdom" in the practical way described by Arthur C. Clark when he said, "True wisdom lies in grasping the tool one needs." (17)

Students are encouraged to produce professional looking products as assignment submissions and this is entirely reasonable because every one of our students has virtually unlimited access to microcomputers, wordprocessing packages, spreadsheets and other software tools. Perhaps without really planning it, we have evolved a "computing intensive environment" where students must use computers to assist them in nearly every aspect of their work. (18)

The courses themselves are quite different from their predecessors. Again my examples are taken from systems courses now under development. Students in them will learn more; the courses have more content, so much in fact we could not reasonably deliver all topics in lecture mode even if we wanted to. Students will learn by doing, there are more assignments and the style of them promotes active learning. This is an important advance for us because traditionally, systems courses have been rather unstimulating for students and less than exciting to teach.

In any case, we think this pattern has now been broken because we will provide better written course materials, we will require the student use a number of software tools and generally make the student more responsible for his/her own learning.

Cheating on assignment work, submitting other people's work, whatever you wish to call it, has been a serious concern of ours. It has not been practical to create unique individual assignments given our resources and overall approach. Now however, we feel we have in the making an innovative way to create , for some topics, assignments that forces original work from each student and which highlights any attempts to foil the process.

Last year for the data processing management course which is given in 6th semester, I provided one assignment package that covered every major course module. This was done early so that students could gauge the total course assignment load and plan accordingly. Every student received the exact same package, so no I did not attempt to generate 70 or 80 unique assignment sets. Instead, the the assignment consisted of an incomplete case study along with six question sets each addressing a major area in the course. The case described in part, the structure and issues confronting the information systems department of a medium sized manufacturing company. Students were required to complete the case following some general guidelines and were strongly encouraged to be creative and even humourous. They were expected but not told, to study the parts of the assignment package carefully, discuss it with their colleagues to try and get a broad understanding of the areas in the case that would have to be expanded before actually attempting any of the questions.

For example, one part of the assignment dealt with hiring and firing, so students had to invent a problem employee, various events involving this employee and also come up with a management process to document performance and discipline problems and propose a course of action. Students were expected to draw on their co-op work experiences and I remember cautioning them not to use real names!

Interestingly, it motivated some (perhaps more than I realized) to really dig into the course text, search out additional reference material and not wait for me to deal with a particular topic in the classroom. Near the end of the semester, one or two students were giving me things to read (probably to improve the quality of my presentations) and many, along the way, asked my help in finding reference material for topics dealt with too lightly by the text.

What pushed students to really get into this assignment? I think at least two things. It was hard work and therefore worth more in terms of contribution to the final grade than most assignments traditionally given in the program and the student had more control over the entire process. From my viewpoint, it obviously forced more discussion and co-operative problem solving and helped in some small way to exercise and improve the students' writing skills.

We plan to extend this approach to more of our courses as we re-develop them.

For a long time now we've used student teams to work through large systems analysis and design projects mostly to hone human relations and organizational skills the students will need when they work on actual systems development projects in industry.

Recently we have considered adapting this approach for programming assignments and we think we might set it up this way: two students will work together as a programming team and each person will write their version of the program, dividing up the planning and pre-coding work as they see fit. Each person will have to critique the other's program (a walkthrough approach) and it is expected that team members will help each other with syntax and logic problems. Students will submit their complete working programs any additional documentation and a diary-style account of what they did, what difficulties they ran into, how they handled them and where they disageed on matters of approach and style. We think this can work, be a richer learning activity and again, better prepare students for the workplace.

By the way, we have a reputation for giving very tough assignments. A few months ago, a graduate now working as a programmer-analyst for a major Canadian bank told me that some of her college programming assignments were more difficult than any of the real world programs she had written up to that time.

Yes assignments are generally difficult and usually not much fun. We think innovations in this area like the ones just described add a little more enjoyment to the process without taking away the necessary rigour.

There seems to be many, possibly too many, definitions of innovation. I subscribe to, "that which is newly introduced.", which obviously is rather different than "that which is new". The things I have described here are not new but their place and time of introduction may just be.

So where are these innovations exactly? Well, I think they are in the courses themselves where a new emphasis on building long-lasting, adaptable skills is paramount. They are in the course assignments where the strategy is to get the student to actually do more and then reward the efforts accordingly. This notion was described by Richard Paul when he wrote, "More and more students should have assignments that stimulate and encourage their ability to think for themselves." [19] Innovation is also in other things we have implemented recently that attend the teaching-learning process but are not a direct part of it.

WHAT'S AHEAD?

Last year at the 15th Annual Conference of the League for Innovation in the Community College, former chairman of the Science Council of Canada, Dr. Stuart Smith said community colleges are "better placed than anyone" to be able to foresee and prepare for society's trends. Smith urged colleges to "modularize" education to meet specific student needs and warned that if colleges are not responsive, private sector trainers will emerge to do this important job. [20] At a different gathering, this time the annual meeting of the Association of Colleges of Applied Arts and Technology of Ontario, Smith proposed that half of Ontario's colleges should become degree-granting polytechnical institutes to attract more students to technology programs. [21]

In our department modularization has already been partially implemented and I believe successfully. Innovations in the recruitment process will continue in order to increase the supply of students motivated to find careers in technology. For example some of us have discussed the idea of running a computer programming contest for high school students as a way to build relationships with those young people who are prospective computer studies students. Such an event has been run successfully at John Carroll University in Cleveland, Ohio and we could probably learn a lot from them. [22]

Curriculum development will continue to be driven by a sharpened sensitivity to building quality into each and every aspect of the teaching-learning process. Most likely we will refine the recently implemented early assessment system to alert us to problems students are encountering with their studies.

In any case we will continue to challenge our students to perform to their best potential by maintaining high standards in teaching and in curriculum.

Early this year, Richard Hook conducted a study of perceptions of Ontario colleges, their graduates and their faculty. This survey, commissioned by the Central Senior Academic Officers, put 160 questionnaires in the hands of secondary school teachers and employers.[23] Responses to questions about college faculty showed they are perceived to be current and hardworking but more traditional than innovative. As we enter the nineties to meet the the challenges touched on earlier here, let us demonstrate that this last perception is clearly wrong.

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